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United States
Department of
Agriculture

**Forest
Service**

Southwestern
Region

Forest Pest Management Report

R-3 83-12

WESTERN SPRUCE BUDWORM
SUPPRESSION PROJECT--1982

Carson National Forest
and State and Private Lands
New Mexico
April 1983

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New Mexico

April 1983

Prepared By

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INTRODUCTION

During June 1982, a suppression project was conducted against the western spruce budworm (WSBW), Choristoneura occidentalis Free., on the Carson National Forest (NF) and State and private lands in the Moreno Valley. This report documents the objectives, methods, and results of this suppression project.

During the years 1976 to 1981, western spruce budworm-caused defoliation increased from approximately 81,760 to 135,025 acres on the Carson NF. In the Moreno Valley, defoliation increased from fewer than 1,000 acres in 1979 to approximately 37,780 in 1981.

Based on an environmental analysis,[1] the alternative direct suppression was selected to mitigate the effects of this western spruce budworm outbreak on a portion of the Carson NF and on State and private lands in the Moreno Valley.

Early in 1982, project plans were prepared to aerially treat with insecticides approximately 70,000 acres of budworm-infested Federal, State, and private lands. The criteria for selecting treatment areas were based on a strategy which called for suppressing early stage infestations only (1 to 3 years of visible defoliation) to obtain lasting suppression results. Based on this strategy, the following areas were aerially treated with insecticides during June 1982: (1) El Rito and Tres Piedras Ranger Districts, Carson NF, 34,265 acres; (2) Questa Ranger District, Carson NF, 1,488 acres; (3) Moreno Valley, State and private lands, 32,594 acres.

OBJECTIVES

Objectives were to:

1. Reduce WSBW populations to as low a level as possible so that predators and parasites, in conjunction with density independent factors, such as weather, exert considerable population regulation.

2. Keep tree damages below economic levels.

3. Prevent spread of WSBW infestations onto adjacent uninfested lands.

4. Prevent severe defoliation.

PROJECT ORGANIZATIONAL STRUCTURE

The project was organized into two distinct zones under the direction of a single administrative team. Zones were established basically because of the need to operate from two separate airport facilities.

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[1] The Record of Decision for the Western Spruce Budworm Management Plan, Final Environmental Impact Statement, Carson National Forest, dated October 27, 1981.

The Carson NF zone consisted of treatment areas 1 and 2 (figures 1 and 2). Spraying operations for the Carson NF zone were based at the Taos Airport. The State and private zone consisted of treatment area 3 (figures 3 through 8) and spray operations were based at the Angel Fire airstrip.

Personnel from Forest Pest Management, State and Private Forestry, Southwestern Region; Carson NF; New Mexico Department of Agriculture; and the New Mexico Department of Natural Resources administered the project. Additional personnel from Forest Pest Management, Northern Region, and Washington Office provided assistance. Appendix C contains organizational charts.

INSECTICIDES

Carbaryl (Sevin 4 oil[2]) was applied at 0.5 gallon per acre (1 pound active ingredient). Carbaryl has proven effectiveness against the WSBW in the Southwest.

Bacillus thuringiensis (B.t.) was applied at 1 gallon per acre (8 billion international units active ingredient). B.t. has been extensively tested against the WSBW with varying success. A 1981 pilot test in New Mexico produced satisfactory results leading to the decision to use B.t. operationally.

The insecticide strategy was to treat sensitive and riparian areas with B.t. and treat the remaining areas with carbaryl.

Background information on both carbaryl and B.t., including environmental hazards, can be found in Appendix B, Draft Environmental Impact Statement, Carson National Forest, dated February 20, 1981.

SPRAY BLOCKS

Treatment areas (figures 1 through 8) were divided into spray blocks, except for the Red River treatment area which was considered as one spray block. Each spray block was designed to make foliage and larval development as uniform as possible, have access for population sampling, and have good identifiable natural and manmade boundaries.

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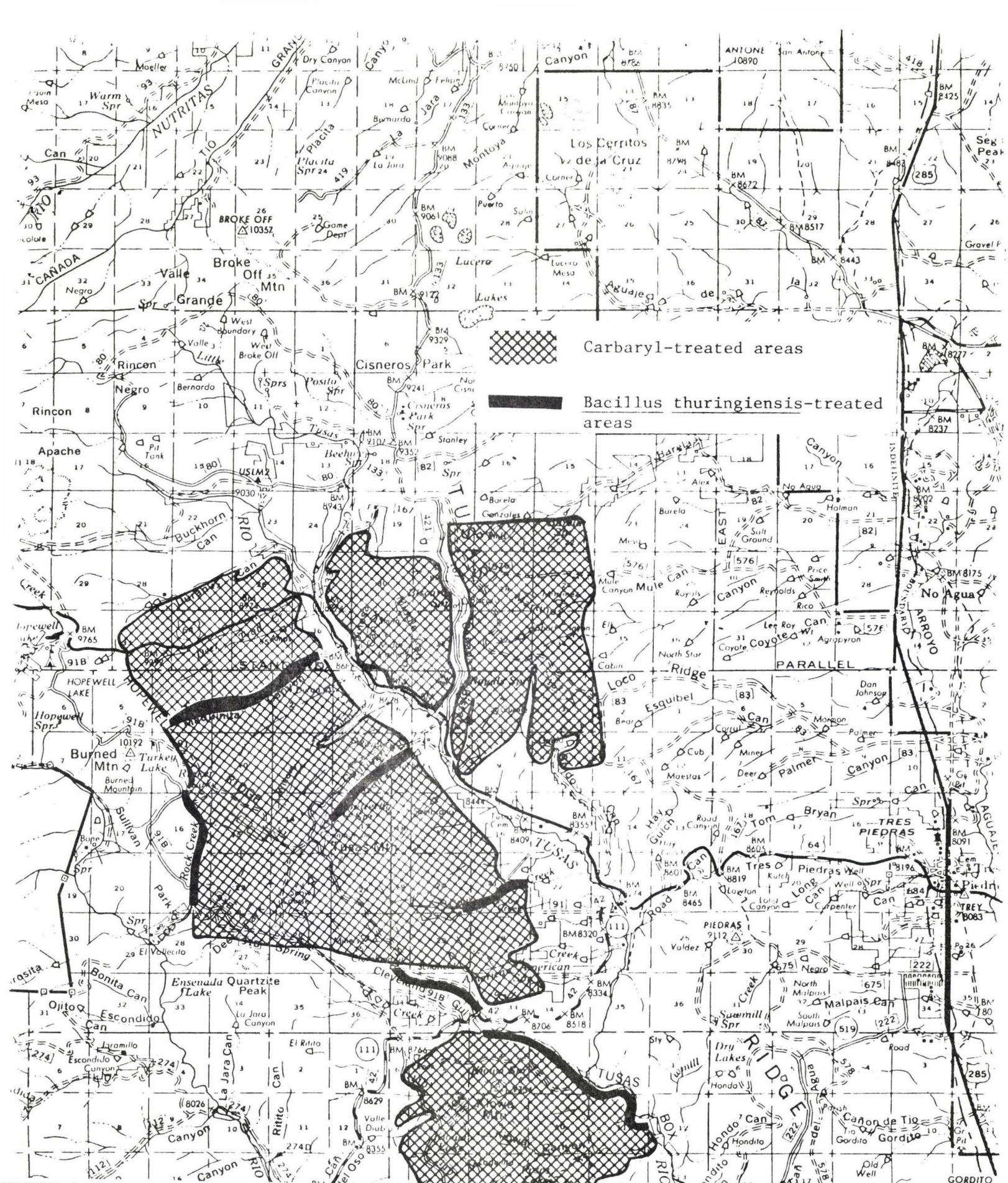
[2] Union Carbide Corporation trade name for carbaryl insecticide; 4 pounds active ingredient per gallon.


Carbaryl-treated areas
Bacillus thuringiensis-treated areas
Los Cerritos de la Cruz
Cisneros Park
Rincon
Apache
Burned Mtn
Tusas Mtn
Tres Piedras
Piedras
Gordito
Las Tablas
Red Mesa
No Agua
Hopewell Lake
Ensenada Quartzite Peak
Dry Lakes
Rio Grande
Rio Tusas
Rio Chama
Rio Box
Rio Arroyo Parallel
Rio Canada
Rio Nutritas
Rio Tio
Rio Ritito
Rio Agua
Rio Aguaje
Rio Tres Piedras
Rio Hondo
Rio Gordito
Rio Serrulle
Rio Loco
Rio Esquibel
Rio Rock Creek
Rio Hopewell
Rio Buckhorn
Rio Bernardo
Rio Placita
Rio Jara
Rio Montoya
Rio Lucero
Rio Aguajes de la Lucera
Rio Cisneros
Rio Posito
Rio Beehive
Rio Stanley
Rio Valle Grande
Rio Valle Dividing
Rio Valle Negro
Rio Valle Little
Rio Valle West Boundary
Rio Valle West Broke Off
Rio Broke Off Mtn
Rio Broke Off
Rio Game Dept
Rio Dry Canyon
Rio Warm Spr
Rio Moeller
Rio Mesa
Rio Canyon
Rio Ojito
Rio Escondido
Rio Jaramillo
Rio Escondido Canyon
Rio La Jara Canyon
Rio Bonita Can
Rio Sullivan
Rio Park
Rio Spr
Rio El Vallecito
Rio Dee Spring
Rio Cleveland
Rio American
Rio Tom Bryan
Rio Hay Gulch
Rio Road Canyon
Rio Long Can
Rio Carpenter
Rio Piedras Well
Rio Tres Piedras Kutch
Rio Lawton
Rio Tusas Creek
Rio Tusas Canyon
Rio Tusas Cem
Rio Tusas Valle Diablo
Rio Tusas Valle Grande
Rio Tusas Valle Oso
Rio Tusas Valle Ritito
Rio Tusas Valle Rincon
Rio Tusas Valle Tusas
Rio Tusas Valle Valdez
Rio Tusas Valle Negro
Rio Tusas Valle Sawmill
Rio Tusas Valle Malpais
Rio Tusas Valle Dry Lakes
Rio Tusas Valle Hondo
Rio Tusas Valle Hondito
Rio Tusas Valle Old Well
Rio Tusas Valle Miller
Rio Tusas Valle Cedar
Rio Tusas Valle Las Tablas
Rio Tusas Valle Big Rock
Rio Tusas Valle Alire Spr
Rio Tusas Valle Pinos Spr
Rio Tusas Valle Tres Piedras Well
Rio Tusas Valle Tres Piedras Spr
Rio Tusas Valle Tres Piedras Cem
Rio Tusas Valle Tres Piedras Kutch
Rio Tusas Valle Tres Piedras Lawton
Rio Tusas Valle Tres Piedras Long Can
Rio Tusas Valle Tres Piedras Carpenter

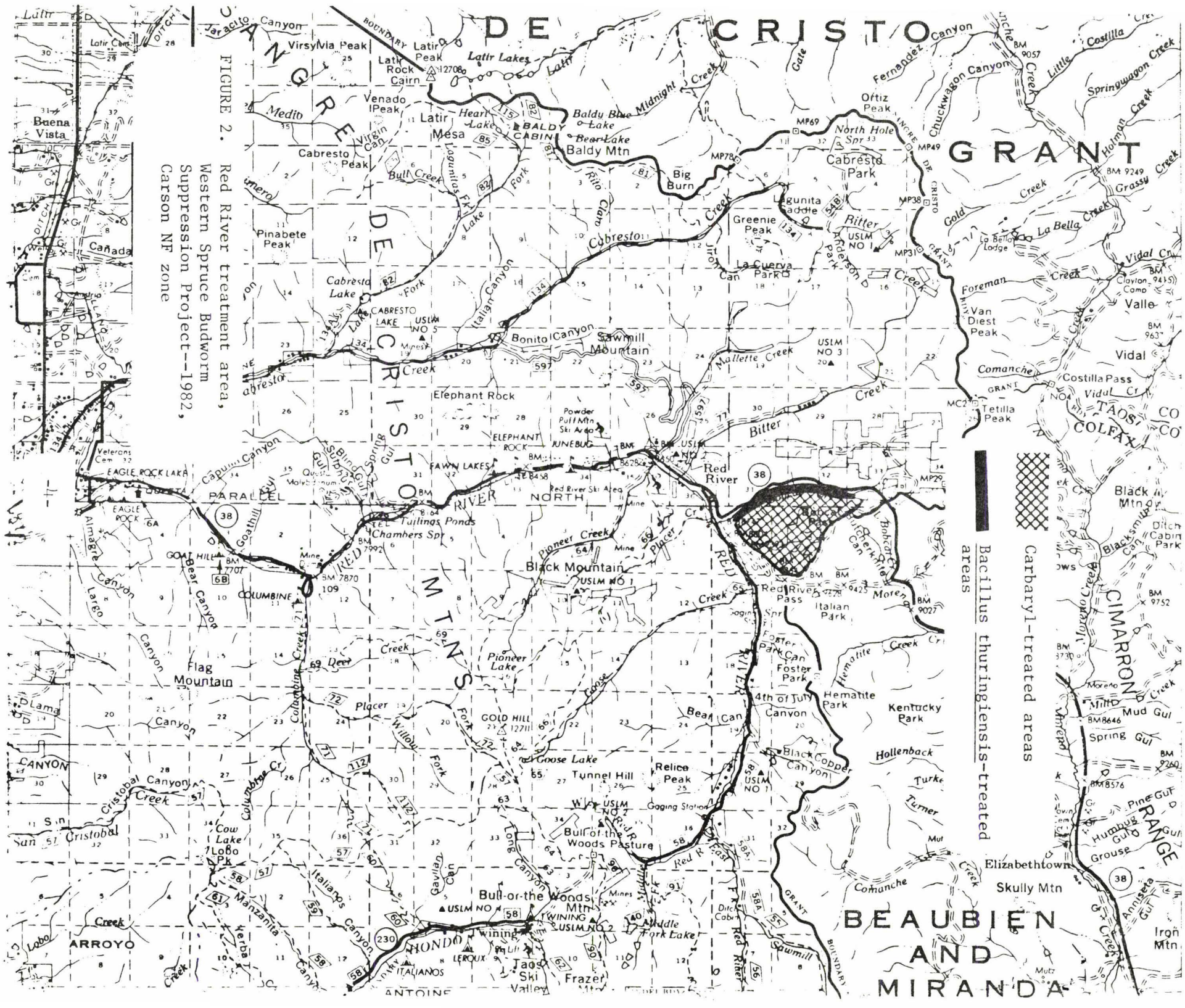


FIGURE 2. Red River treatment area, Western Spruce Budworm Suppression Project--1982, Carson NF zone

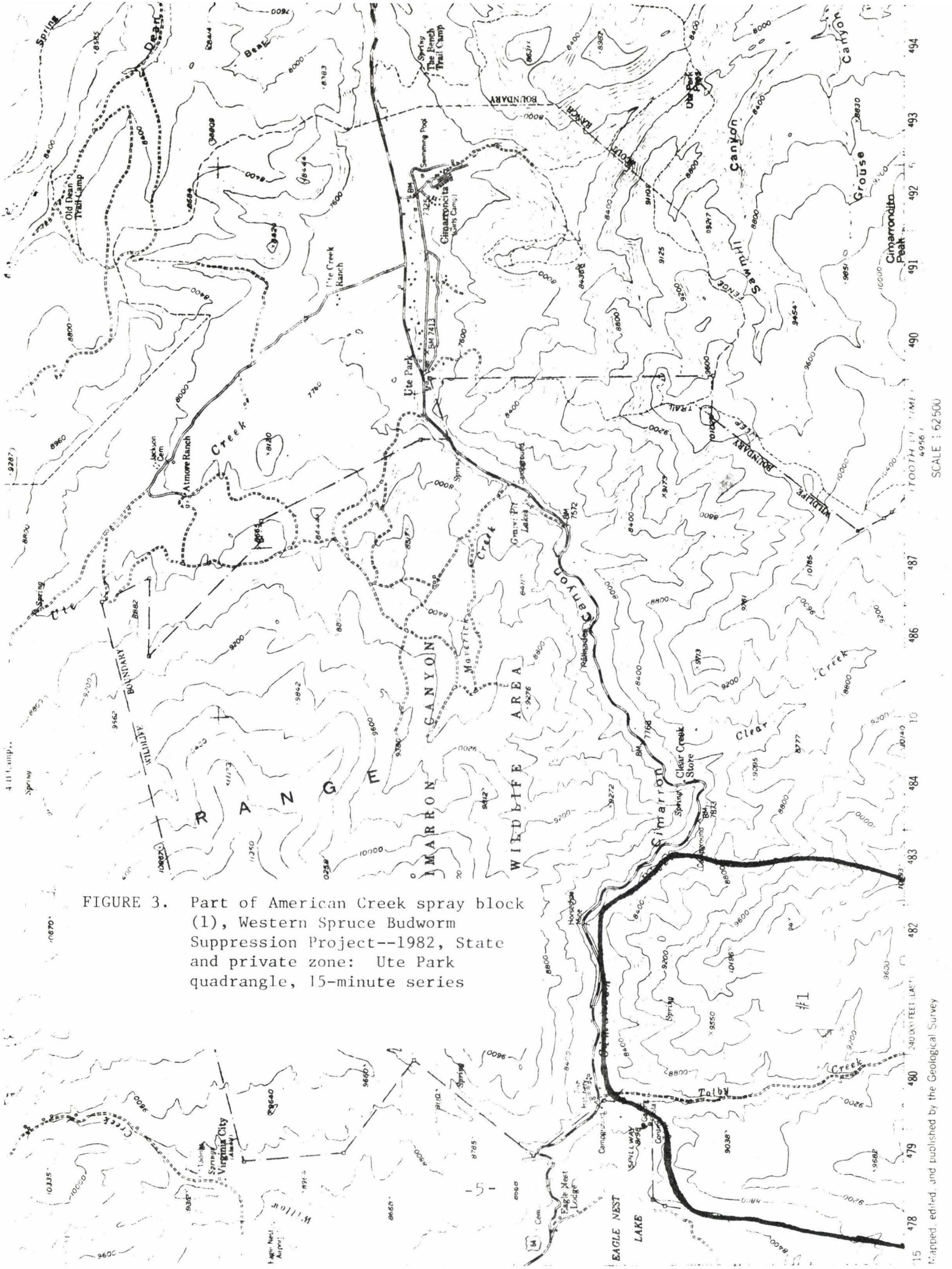


FIGURE 3. Part of American Creek spray block (1), Western Spruce Budworm Suppression Project--1982, State and private zone: Ute Park quadrangle, 15-minute series

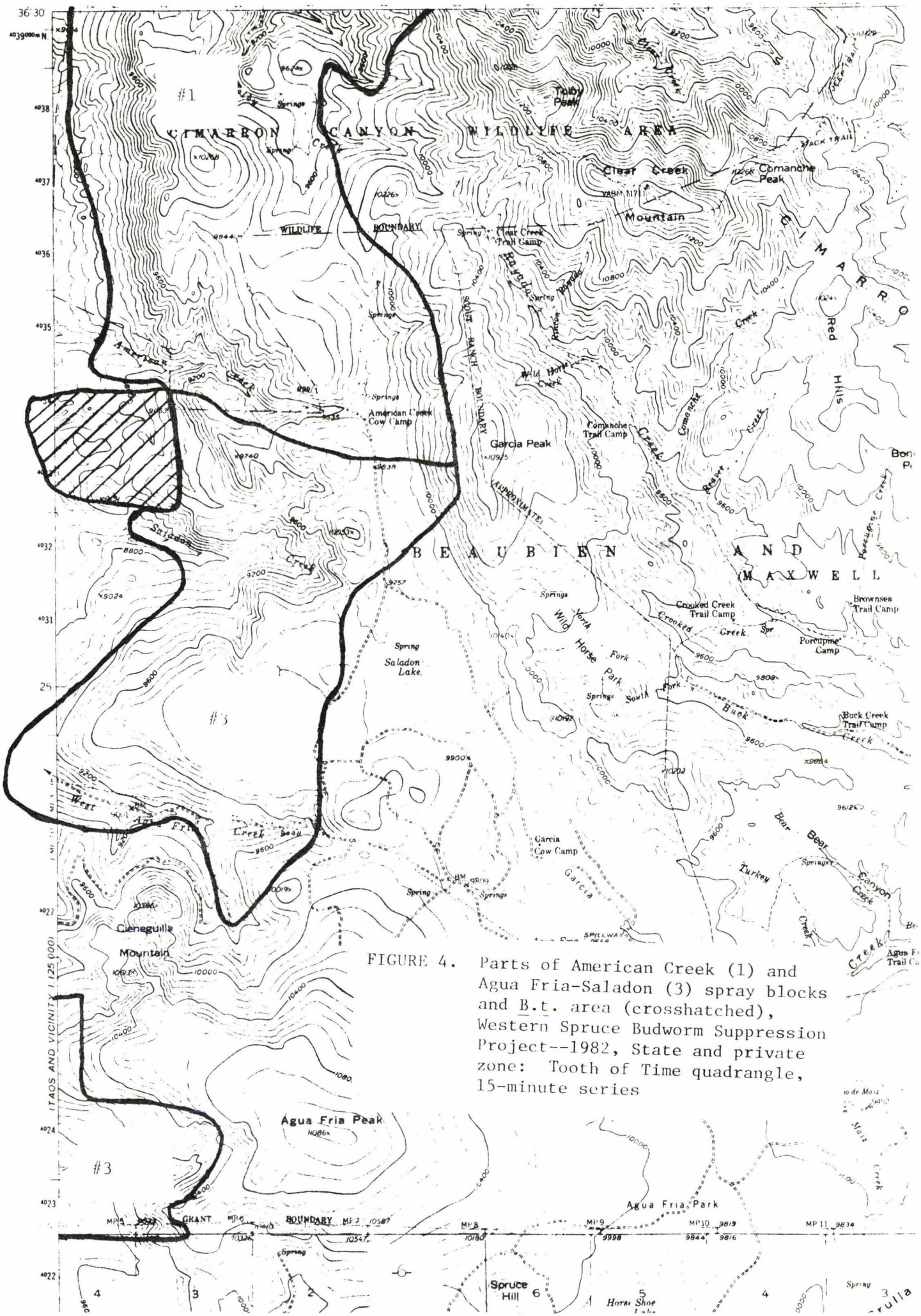
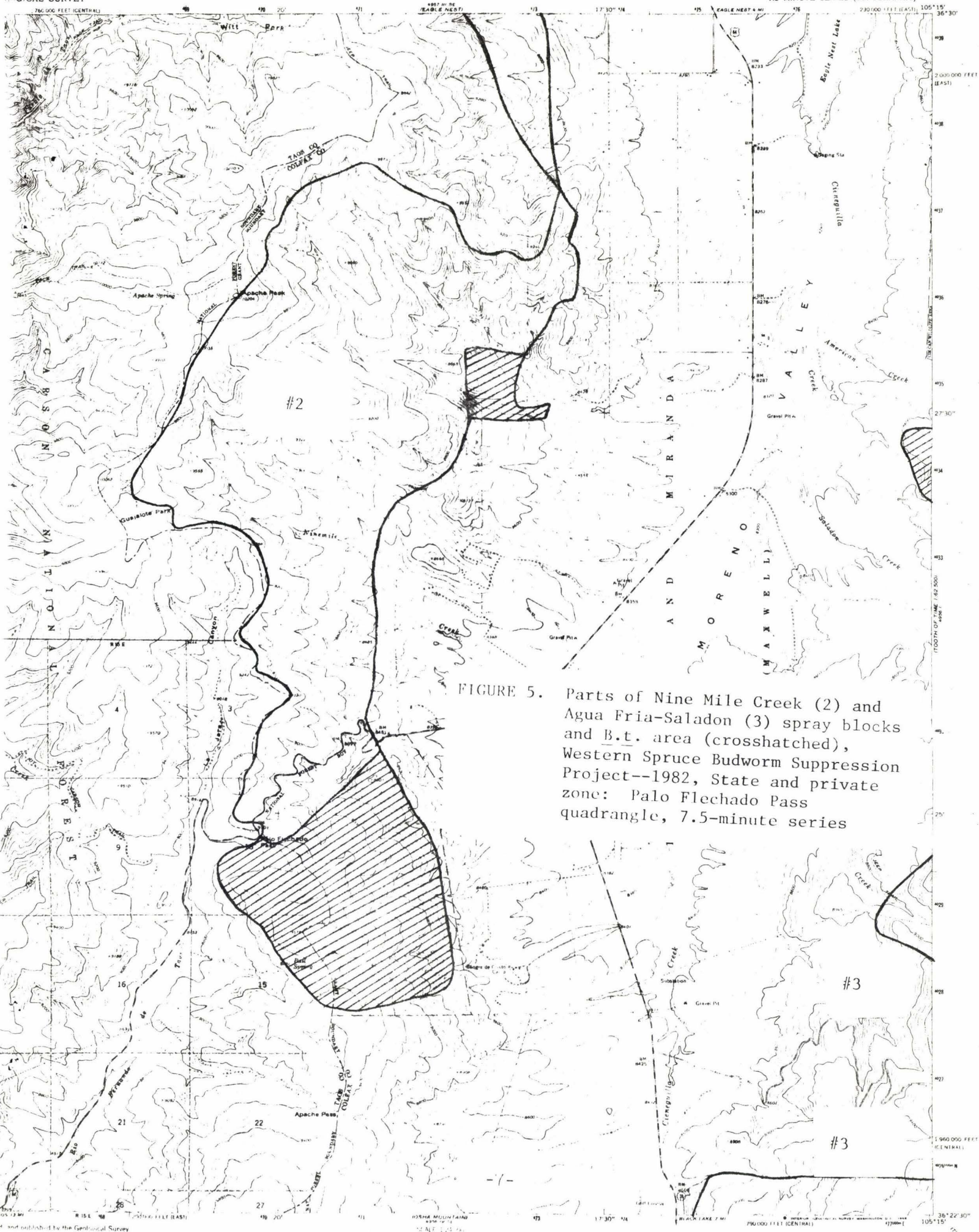


FIGURE 4. Parts of American Creek (1) and Agua Fria-Saladon (3) spray blocks and B.t. area (crosshatched), Western Spruce Budworm Suppression Project--1982, State and private zone: Tooth of Time quadrangle, 15-minute series


#2
#3
#3
Witt Park
Apache Peak
Apache Spring
Guadalote Park
Nineml le
Apache Pass
Eagle Nest Lake
Cienequilla
Gravel Pit
Gravel Pit
Gravel Pit
Saladon Creek
American Creek
Creek
Creek

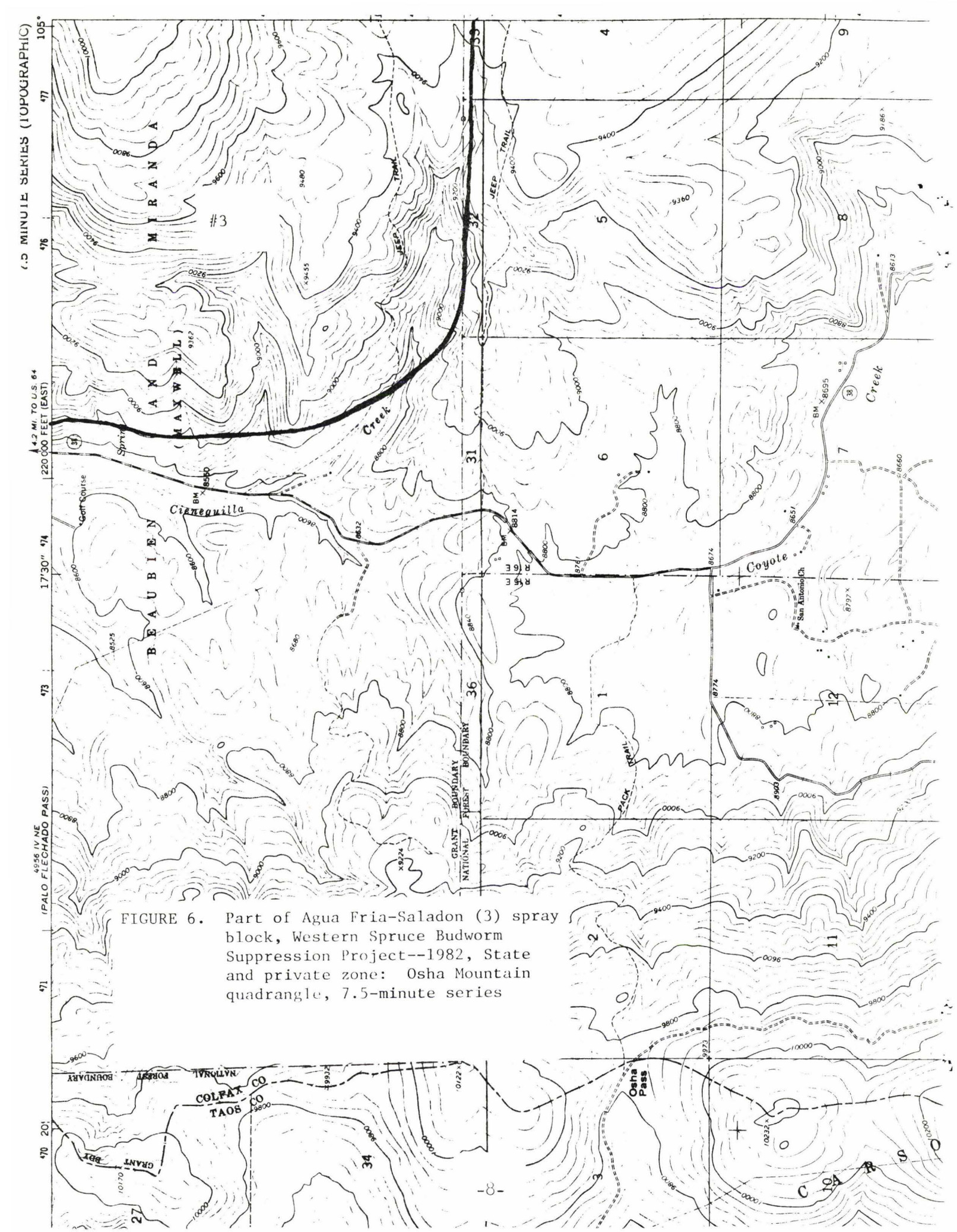


FIGURE 6. Part of Agua Fria-Saladon (3) spray block, Western Spruce Budworm Suppression Project--1982, State and private zone: Osha Mountain quadrangle, 7.5-minute series

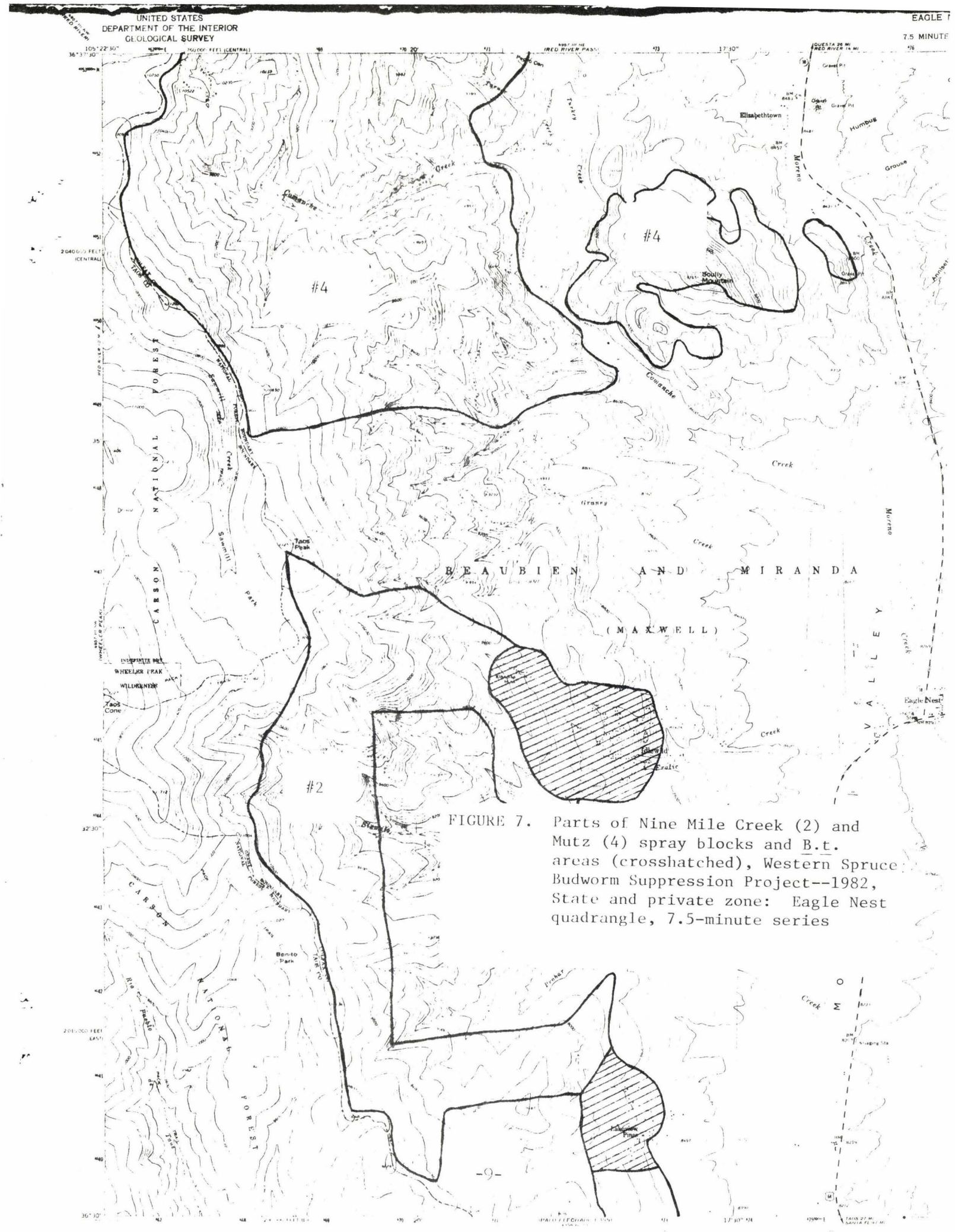


FIGURE 7. Parts of Nine Mile Creek (2) and Mutz (4) spray blocks and B.t. areas (crosshatched), Western Spruce Budworm Suppression Project--1982, State and private zone: Eagle Nest quadrangle, 7.5-minute series

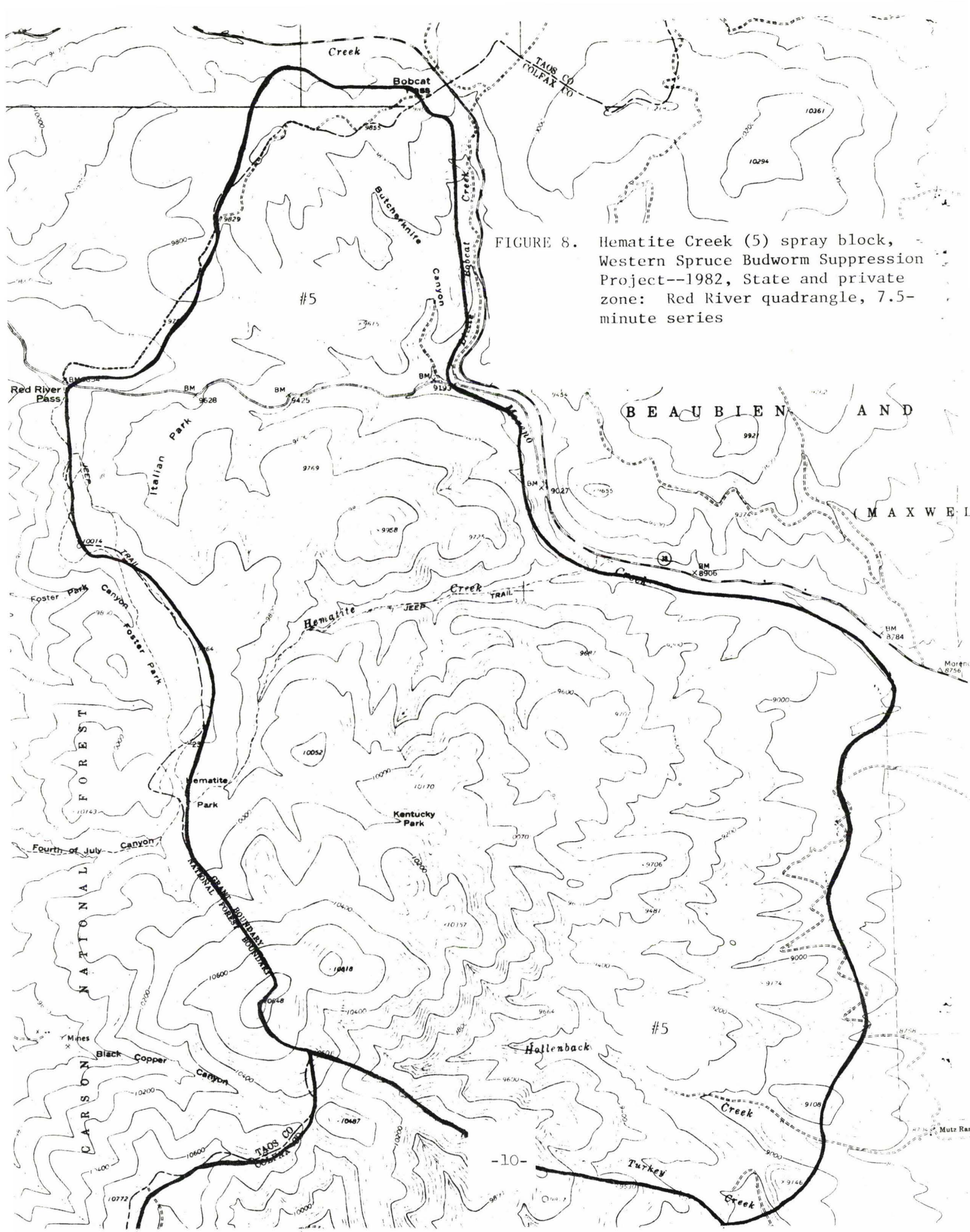


FIGURE 8. Hematite Creek (5) spray block, Western Spruce Budworm Suppression Project--1982, State and private zone: Red River quadrangle, 7.5-minute series

Names and gross acreages of the treatment blocks were as follows:[3]

Forest Service zone

	Spray block	Acreage
1.	Biscara Canyon	5,500
2.	Hopewell	7,000
3.	Long Canyon	4,500
4.	Rock Creek	4,800
5.	Tusas Mountain	7,000
6.	Kiowa Mountain	7,600
7.	Red River	2,000
	Total	38,400
	B.t. Total	1,039

State and private zone

	Spray block	Acreage
1.	American Creek	6,500
2.	Nine Mile Creek	6,200
3.	Agua Fria-Saladon	8,000
4.	Mutz	4,300
5.	Hematite Creek	4,800
	Total	29,800
	B.t.	1,780
	Total	31,580

TIMING OF SPRAY APPLICATION

For maximum efficiency, carbaryl was applied when 20 percent of the budworm population was in the fifth instar. B.t was applied when 50 percent of the budworm population was in the fourth larval instar. To determine the average larval instar percentage, sampling began on May 26, 1982, and continued until June 16, 1982, on the Carson NF zone; and began on May 28, 1982, and continued until June 17, 1982, on the State and private zone.

Developmental sampling consisted of cutting two 15-inch apical, mid-crown branches from an open-grown, 30- to 60-foot tall, Douglas-fir at each of 10 developmental sample plots on each spray block. In the field laboratory, all larvae were removed, placed in alcohol, and the instar determined. Average percentage of the budworm population in each instar was computed for each sampling date and each spray block.

WEATHER FORECASTING AND MONITORING

Local weather forecasts were provided each day to zone directors. These forecasts were obtained by the project meteorologist from the National Weather Service office in Albuquerque, New Mexico. National Oceanic and Atmospheric Administration meteorologists used onsite weather data collected the previous day and telephoned to Albuquerque to adjust their forecast to local situations.

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[3] The actural acreage treated differs slightly due to the availability of insecticides. Tables 1 through 4 display actual acreage treated.

APPLICATION

The pesticides were applied using turbine-powered fixed-wing aircraft. The VMD, as determined by the D-Max method (Maksymiuk 1963),[4] ranged from 180 to 200 microns, depending on nozzle orientation, for carbaryl, and 276 microns for B.t.

Two observation helicopters were used to direct spraying operations on each zone. Observers in these helicopters directed spray aircraft by hovering at each end of the spray swaths. Aerial observers checked to see that spray aircraft were spraying within treatment block boundaries, had proper spray swath overlap, shut off over sensitive areas, and insured that safety procedures were followed.

Spraying of carbaryl began on June 13, 1982, and continued until June 21, 1982, on both the Carson NF and State and private zones. B.t. was sprayed on June 18, 1982, on the Carson NF zone, and started on June 12, 1982, and continued until June 17, 1982, on the State and private zone. Tables 1 through 4 show the spray dates and acres treated for each spray block.

SPRAY DEPOSIT ASSESSMENT

Spray deposition was estimated by placing Sudan Black cards for carbaryl and white Kromekote cards for B.t. within the spray blocks early in the morning just prior to spraying. Two cards were placed in a clearing near each cluster plot. If possible, cards were placed at least one tree height in distance from any other tree so as not to be in the spray shadow of a tree. Fifty cards were placed on each spray block. Plastic cardholders developed by the Missoula Equipment Development Center were used to hold the cards.

No dye was added to the carbaryl spray mixture. Droplets were counted on the cards at the field laboratory. Using a template, spray droplets in 4 square centimeters in the center of each card were tallied. The mean number of spray droplets per square centimeter per card was then calculated.

For one B.t. spray area on the State and private zone, white Kromekote cards were used and Rhodamine B dye was added to the spray mixture. Spray droplets were tallied as described for carbaryl.

Spray deposit on the six Carson NF zone spray blocks ranged from 9.4 to 36.8 drops per square centimeter, averaging 18.1 drops per square centimeter (table 5). This droplet density was sufficient to attain good mortality levels.

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[4] Maksymiuk, Bohdan. 1963. How to estimate the atomization of oil-base aerial sprays by the D-Max method. Forest Service Research Note WO-1. USDA Forest Service, Washington, DC. 6 pp.

TABLE 1. Spray dates and acres treated with carbaryl for each spray block, Carson NF, 1982 WSBW suppression project

Block	Date of application	Acres treated	
		Daily	Total
Kiowa	June 13	3,751	5,551
	June 14	1,800	
Tusas-Willow	June 16	6,102	
	June 18	1,400	
	June 20	1,800	
	June 21	2,280	11,582
Biscara-Martinez	June 17	6,300	
	June 18	1,400	
	June 21	2,650	10,350
Hopewell	June 20	4,345	4,345
Red River	June 20	1,380	1,380
Rock Creek	June 21	1,506	1,506
Total			34,714

TABLE 2. Spray dates and acres treated with B.t. for each spray block, Carson NF, 1982 WSBW suppression project

Block and local	Date of application	Acres treated	
		Daily	Total
Kiowa			
Tusas Box	June 18	500	500
Tusas-Willow			
Cow Creek	June 18	31	
Maquinita Canyon	June 18	150	
Cunningham Gulch	June 18	100	281
Red River			
Bobcat Creek	June 18	108	108
Rock Creek			
Cleveland Gulch	June 18	50	
Rock Creek	June 18	100	150
Total			1,039

TABLE 3. Spray dates and acres treated with carbaryl, State and private zone, 1982 WSBW suppression project

Block	Date of application	Acres treated
American Creek	June 13	6,400
Nine Mile American Creek	June 14	4,300
Agua Fria-Saladon Nine Mile	June 15	5,800
Agua Fria-Saladon	June 16	4,800
Mutz	June 17	3,000
Hematite Mutz	June 21	5,337
Total		29,637

TABLE 4. Spray dates and acres treated with B.t., State and private zone, 1982 WSBW suppression project

Block and local	Date of application	Acres treated
American Creek Tolby Canyon	June 12	400
Nine Mile Creek Agua Fria-Saladon	June 14	500
Nine Mile Creek Agua Fria-Saladon	June 16	600
Nine Mile Creek Idlewild Lakeview Pines Hematite Creek	June 17	1,457
Total		2,957

TABLE 5. Average spray deposit on each spray block, Carson NF, 1982 WSBW suppression project

Spray block	Average spray deposit drops per square centimeter
Kiowa	19.1
Tusas-Willow	19.7
Biscara-Martinez	9.1
Hopewell	36.8
Red River	9.4
Rock Creek	14.6
Spray project average	18.1

On the State and private zone, spray deposit on the five carbaryl blocks ranged from 5.2 to 9.0 drops per square centimeter, averaging 7.4 drops per square centimeter. The one area monitored during B.t. spraying showed 6.9 drops per square centimeter. These results are presented in table 6. Although the droplet densities are less than is generally desired, the percent mortality and residual population levels resulting from the spray application reached satisfactory levels. Appendix A displays spray deposit data by plot.

ENVIRONMENTAL MONITORING

The USDA Fish and Wildlife Service monitored the aquatic environment of three small creeks--Bobcat, Tusas, and Rock--within the Carson NF zone during spray operations. Monitoring consisted of: (1) Taking substrate samples prior to treatment with a Surber sampler to determine aquatic insect diversity and relative abundance, and (2) obtaining 10-minute drift samples every hour for several hours during the morning of treatment days.

Aquatic monitoring revealed that insecticide drift caused by wind currents and temperature variations in the local topography around Bobcat Creek resulted in a minor setback for aquatic insect fauna. This setback was considered temporary. The aquatic insect fauna in Tusas and Rock Creeks experienced no adverse effects from the insecticide carbaryl. Detailed methods and results are presented in a separate report (Kennedy and Sanchez 1982)[5] on file at Forest Pest Management, Albuquerque, New Mexico.

Wildlife personnel assigned to the Carson NF monitored the effects of the spray operation on avians on the Carson NF zone. No adverse effects were observed.

On the State and private zone, the New Mexico Department of Agriculture, Division of Agricultural and Environmental Services, Bureau of Pesticide Management, monitored the aquatic and atmospheric environments. Air samples were taken near spray block boundaries before and during spray operations. Water samples were taken from streams in or near spray blocks prior to spraying, 1 hour after spraying, and at various times 2 to 30 days after spraying. No pesticide was detected by the air samples. Only four water samples had detectable levels of carbaryl. No carbaryl was detected in the water samples after 8 days postspray.

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[5] Kennedy, H. D., and C. Sanchez, Jr. 1982. The effects of an aerial application of Sevin 4 oil to three creeks in the Carson National Forest as part of a U.S. Forest Service spruce budworm suppression project. USDI Fish and Wildlife Service, Special Report, Pesticide Field Appraisal.

TABLE 6. Average spray deposit on each spray block, State and private zone, 1982 WSBW suppression project

Spray block	Average number of drops/cm^2
Carbaryl	
American Creek	8.6
Nine Mile Creek	8.0
Agua Fria-Saladon	6.1
Mutz	5.2
Hematite	9.0
Spray project average	7.4
B.t.	
Hematite Creek	6.9

Results are presented in a separate report (Lasswell 1982)[6] on file at Forest Pest Management, Albuquerque, New Mexico, and at New Mexico Department of Agriculture, Las Cruces, New Mexico.

EVALUATING PROJECT EFFECTIVENESS

Effectiveness of the pesticide treatments was evaluated by measuring larval mortality of the 1981-82 budworm generation. Larval mortality was determined by sampling the budworm population on each spray block 1 day prior to spraying and 7 and 14 days after spraying.

Sampling design consisted of 25 plots, each a 3-tree cluster, per spray block. Plots were established throughout spray blocks near roads and trails. The three trees constituting a sample plot were located within 1 acre. The plot constituted the primary sampling unit. Plot means were computed by averaging larvae per 100 buds for each branch sampled on each tree, and then averaging the 3 trees. Larval means and standard errors were calculated for each spray block. Sampling was performed in the usual manner and is described in detail on page 87, USDA Forest Service, Western Spruce Budworm Suppression and Evaluation Project Using Carbaryl 1977, Progress Report No. 1, R-3 78-11.

Carson National Forest Zone

On the Carson NF zone, mean percent WSBW mortality (unadjusted) for the Tres Piedras and Red River treatment areas was 81.6 and 91.6, respectively. WSBW larvae per 100 buds were 4.5 for Tres Piedras and 1.3 for Red River at 14 days after treatment. Prespray, 7- and 14-day postspray mean larval densities, and percent mortality for each treatment area and spray block are presented in table 7. Appendix B contains the mean larvae per 100 buds for each cluster sample plot for prespray and 7- and 14-day postspray samples on each spray block.

State and Private Zone

Average percent mortality (unadjusted) for the carbaryl-treated blocks was 72.8. The average percent mortality for the B.t. areas that were monitored was 58.8. Prespray and 14-day postspray larval densities (larvae per 100 buds) were used to calculate these percentages. Seven-day postspray larval samples were taken to show mortality trends. These data are presented in table 8.

Fourteen-day postspray larval densities ranged from 1.8 larvae per 100 buds on the Mutz block, to 5.3 larvae per 100 buds on the Agua Fria-Saladon block. These densities represent 80.6 percent and 65.1 percent mortality, respectively. B.t.-treated areas averaged 3.5 larvae per 100 buds at 14 days postspray, a 58.8 percent mortality. Appendix B shows mean larvae per 100 buds for each cluster sample plot for prespray and 7- and 14-day postspray samples.

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[6] Lasswell, G. L. 1982. Western spruce budworm control program, Colfax County, Eagle Nest-Angel Fire.

TABLE 7. Mean larvae per 100 buds for prespray, 7- and 14-day post-spray samples, and percent mortality (unadjusted), Carson NF, 1982 WSBW suppression project

Treatment area/spray block	Larvae per 100 buds			
	Prespray	7-day postspray	14-day postspray	Mortality %
Tres Piedras treatment area				
Kiowa	$\bar{x}$ = 22.3 SE = 2.5 (11%)	$\bar{x}$ = 5.7 SE = 1.7 (29%)	$\bar{x}$ = 5.0 SE = 1.7 (20%)	77.5
Tusas-Willow	$\bar{x}$ = 27.9 SE = 3.1 (12%)	$\bar{x}$ = 12.9 SE = 1.6 (13%)	$\bar{x}$ = 7.9 SE = 1.6 (20%)	71.7
Biscara-Martinez	$\bar{x}$ = 25.8 SE = 5.2 (20%)	$\bar{x}$ = 13.0 SE = 1.7 (13%)	$\bar{x}$ = 3.5 SE = 0.9 (25%)	84.6
Hopewell	$\bar{x}$ = 21.5 SE = 2.5 (12%)	$\bar{x}$ = 3.7 SE = 0.6 (16%)	$\bar{x}$ = 1.4 SE = 0.5 (38%)	93.4
Rock Creek	$\bar{x}$ = 25.0 SE = 3.1 (13%)	$\bar{x}$ = 9.4 SE = 1.6 (17%)	$\bar{x}$ = 4.8 SE = 0.9 (19%)	80.9
	$\Sigma\bar{x}$ = 24.5 SE = 1.2 (5%)	$\Sigma\bar{x}$ 8.9 SE = 1.9 (21%)	$\Sigma\bar{x}$ = 4.5 SE = 1.0 (23%)	81.5
Red River	$\bar{x}$ = 15.0 SE = 1.7 (11%)	$\bar{x}$ = 3.9 SE = 1.0 (26%)	$\bar{x}$ = 1.3 SE = 0.8 (17%)	91.6

TABLE 8. Mean larvae per 100 buds for prespray, 7- and 14-day post-spray samples, and percent mortality (unadjusted), State and private zone, 1982 WSBW suppression project

Treatment area/spray block	Larvae per 100 buds			
	Prespray	7-day postspray	14-day postspray	Mortality %
American Creek	$\bar{x}$ = 11.2 SE = 1.0 (9%)	$\bar{x}$ = 4.3 SE = 0.6 (13%)	$\bar{x}$ = 2.7 SE = 0.4 (15%)	75.7
Nine Mile Creek	$\bar{x}$ = 9.3 SE = 0.9 (9%)	$\bar{x}$ = 3.9 SE = 0.5 (13%)	$\bar{x}$ = 2.3 SE = 0.4 (19%)	75.3
Agua Fria Saladon	$\bar{x}$ = 15.1 SE = 2.2 (14%)	$\bar{x}$ = 6.2 SE = 1.2 (20%)	$\bar{x}$ = 5.3 SE = 0.8 (14%)	65.1
Mutz	$\bar{x}$ = 9.2 SE = 0.9 (10%)	$\bar{x}$ = 3.4 SE = 0.5 (13%)	$\bar{x}$ = 1.8 SE = 0.3 (15%)	80.6
Hematite	$\bar{x}$ = 14.0 SE = 1.4 (10%)	$\bar{x}$ = 4.2 SE = 0.7 (16%)	$\bar{x}$ = 3.9 SE = 3.7 (19%)	71.9
Total	$\Sigma\bar{x}$ = 11.8 SE = 1.3 (11%)	$\Sigma\bar{x}$ = 4.4 SE = 0.7 (15%)	$\Sigma\bar{x}$ = 3.2 SE = 0.5 (17%)	72.8
B.t.	$\bar{x}$ = 8.4 SE = 1.4 (16%)	$\bar{x}$ = 5.9 SE = 0.9 (15%)	$\bar{x}$ = 3.5 SE = 0.5 (14%)	58.8

PROJECT COSTS

The total project costs were $636,500. A breakdown of expenses by zone follows.

Item	Carson National Forest zone	State and private zone
Insecticides		
Carbaryl and carrier	$135,776	$116,000
B.t.	5,088	12,590
Aerial application	47,813	57,037
Helicopter services	7,882	21,000
Sampling, monitoring, and administrative expenses	114,441	118,873
	$311,000	$325,500

Treatment costs per acre were as follows: Carson NF zone, $8.70; State and private zone, $9.99.

CONCLUSIONS

Carson National Forest Zone

The spray project was successful by the stated objectives. Percent mortality and residual larval numbers per 100 buds for the Tres Piedras treatment area, 81.5 and 4.53, respectively, are at acceptable, but not excellent, levels. These estimates are based on all sample plots within spray boundaries. They include sample plots which were unintentionally missed or received low insecticide deposit.

Considering the rapid budworm population buildup in the west division of the Carson NF, areas not treated in 1982 may require treatment in 1983 if any long-term protection is to be realized.

The primary objective on the Red River treatment area was to provide foliage protection in 1982; this objective was obtained. Further, future defoliation can be expected unless the WSBW populations in adjacent areas collapse.

State and Private Zone

Reduction of the budworm population from average prespray levels of 11.77 larvae per 100 buds to 3.20 larvae per 100 buds at 14 days postspray (carbaryl areas) meets the stated objectives of the spray project. Such low residual densities are expected to result in populations below damaging levels for several years without re-treatment. Migration and reinfestation from adjacent forest lands is not expected to be significant due to geographical barriers and lack of contiguous host-type areas.

RECOMMENDATIONS

During this operational suppression project, considerable time and money were expended sampling budworm larvae for insecticide efficacy. It is recommended, for operational projects, the sampling effort be reduced as a cost-saving measure. The following are suggestions to reduce sampling costs and effort:

1. Reduce the number of branches per tree sampled to one.

2. Perform only one postspray sample.

3. Reduce the number of prespray plots, since population variability appears to be less during this sampling period.

4. Increase the number of sample plots during the postspray period to maintain the same level of precision as the prespray sample.

5. Remove and count larvae from sample branches on drop cloths in the field, rather than in a laboratory trailer.

These suggestions will reduce the time and manpower necessary to perform pre- and post-spray sampling. While the precision of the estimates may be somewhat reduced, it will be adequate for the purpose and need of the data.

APPENDIXES

APPENDIX A

SPRAY DEPOSIT CARD DATA

Carson NF Zone

Kiowa Spray Block
Sprayed 6/13, 6/14/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	1	3	6.5
4	13	47	7.5
7	13	40	6.6
10	67	61	16.0
13	53	69	15.3
16	177	323	62.5
19	38	56	11.8
22	--	131	32.8
25	74	123	24.6
28	158	142	37.5
31	123	101	28.0
34	--	--	--
37	123	136	32.4
40	55	87	17.8
43	65	101	20.8
46	46	57	12.9
49	84	92	22.0
52	93	79	21.4
55	8	21	3.6
58	108	100	26.0
61	78	77	19.4
64	53	64	14.6
67	41	42	10.4
70	44	62	13.2
73	0	0	0
Spray block average			19.1

Tusas-Willow Spray Block
Sprayed 6/16, 6/20, 6/21/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
151	7	5	1.5
157	4	2	0.7
163	71	67	17.2
166	115	121	29.5
172	12	18	3.7
181	91	137	28.5
187	37	5	5.2
193	109	108	27.1
199	71	93	20.5
202	189	193	47.7
214	178	154	41.5
220	54	53	13.4
223	71	104	21.9
232	24	23	5.9
235	209	283	61.5
241	123	132	31.9
247	58	54	14.0
253	47	52	12.5
259	157	129	37.7
265	44	42	10.7
268	125	115	30.0
274	27	53	10.0
277	8	6	1.7
283	55	37	11.5
295	--	25	6.2
Spray block average			19.7

Biscara-Martinez Spray Block
Sprayed 6/17 and 6/18/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
517	13	16	3.6
523	75	44	14.9
556	164	110	34.2
562	4	8	1.5
565	79	53	16.5
574	22	30	6.5
583	2	1	0.7
589	17	13	3.7
598	0	0	0
Spray block average			9.1

Hopewell Spray Block
Sprayed 6/20/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
301	124	268	49.0
304	91	84	21.9
307	68	89	19.6
310	95	smeared	23.7
313	116	161	34.6
316	141	143	35.5
319	87	123	26.2
322	31	126	19.6
325	162	164	40.7
328	96	113	26.1
331	172	167	42.4
334	144	124	33.5
337	260	248	63.5
340	176	228	50.5
343	214	196	51.2
346	192	182	46.7
349	210	246	57.0
358	12	13	3.1
361	159	107	33.2
364	280	184	58.0
Spray block average			36.8

Rock Creek Spray Block
Sprayed 6/21/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
76	28	22	6.9
82	0	0	0
85	0	0	0
91	40	29	8.6
94	110	122	29.0
97	7	25	4.0
109	47	45	11.5
112	146	91	29.6
115	81	73	19.2
118	30	26	7.0
121	16	15	3.9
124	32	53	10.6
127	38	60	12.2
130	47	33	10.0
133	24	72	12.0
136	97	36	16.6
139	97	71	20.2
142	101	73	21.7
145	250	146	49.5
148	77	88	20.6
Spray block average			14.6

Red River Spray Block
Sprayed 6/20/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
376	28	66	11.7
379	18	25	5.4
382	16	12	3.5
388	9	16	3.1
391	35	26	7.6
394	96	49	18.1
397	22	68	11.2
400	40	29	8.6
403	47	75	15.2
406	62	70	16.5
409	37	55	11.5
412	22	18	5.0
415	23	12	4.4
Spray block average			9.4

State and Private Zone

Nine Mile Creek
Sprayed 6/15/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	12	63	9.4
2	10	6	2.0
3	1	6	0.9
4	8	6	1.8
5	10	12	2.8
7	37	44	10.1
8	49	40	11.1
9	15	29	5.5
10	56	73	16.1
11	90	36	15.8
13	1	0	.2
14	21	25	5.8
15	17	21	5.0
16	14	21	4.4
17	32	24	7.0
18	26	19	5.6
19	89	98	23.4
20	58	57	14.4
21	23	26	6.1
22	27	37	5.5
23	22	24	5.8
24	22	42	8.0
Spray block average			8.0

American Creek
Sprayed 6/13/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	53	71	15.5
2	106	71	22.1
3	29	49	4.8
4	41	20	7.6
5	30	98	16.0
6	55	57	11.5
7	32	6	4.8
8	49	0	6.1
10	26	62	11.0
11	34	34	8.5
12	47	32	9.9
13	46	51	12.1
14	52	61	14.1
15	96	28	15.5
16	35	17	6.5
17	32	42	9.2
18	2	24	3.2
19	5	10	1.9
20	31	46	9.6
21	13	6	2.4
22	9	4	1.6
23	13	9	2.8
24	15	5	2.5
25	12	0	1.5
Spray block average			8.6

B.t
Sprayed 6/12/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	24	30	6.8
2	20	28	6.0
3	28	27	6.9
4	15	17	4.0
5	42	45	10.9
Spray block average			6.9

Agua Fria-Saladon
Sprayed 6/14/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	26	22	6.0
2	19	23	5.3
3	14	10	3.0
4	18	17	4.4
5	14	14	3.5
6	4	23	3.4
7	7	8	1.9
8	20	42	7.8
9	23	55	9.5
10	24	20	5.5
11	24	37	7.6
12	32	11	5.4
13	18	8	3.2
14	5	8	1.6
15	8	12	2.5
16	5	7	1.5
17	4	14	2.2
18	13	14	3.4
19	40	30	8.8
20	81	21	12.8
21	43	62	11.9
22	51	23	9.2
23	55	73	15.8
24	36	18	6.8
25	60	49	13.6
Spray block average			6.1

Mutz
Sprayed 6/16/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	2	6	1.0
2	29	16	5.6
3	16	21	4.6
4	18		4.5
5	25	24	6.1
6	23	15	4.8
7	9	5	1.8
8	24	18	5.2
9	21	34	6.9
10	13	14	3.4
11	19	36	6.9
12	31	29	7.5
13	19	11	3.8
14	17	13	3.8
15	23	12	4.4
16	31	35	8.2
17	61	45	13.2
18	10	28	4.8
25	11	10	2.6
Spray block average			5.2

State and Private Zone

Hematite
Sprayed 6/21/82

Plot number	Drops/4 cm²		Drops/cm²
	Card 1	Card 2	
1	19	39	7.2
2	37	65	12.8
3	24	21	5.6
4	65	57	15.2
5	35	30	8.1
6	18	6	3.0
7	5	1	0.8
8	84	66	18.8
9	91	57	18.5
10	67	62	16.1
11	49	35	10.5
12	21	22	5.4
13	40	41	10.1
14	30	45	9.4
15	35	34	8.6
16		29	7.2
17	12	14	3.2
18	36	25	7.6
19	43	63	13.2
20	10	26	4.5
21	19	9	3.5
22	37	21	7.2
23	55	53	13.5
24	21	38	7.4
Spray block average			9.0

APPENDIX B

PRESPRAY AND POSTSPRAY DATA

Carson NF Zone

Kiowa Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray Larvae	14-day postspray		
			Larvae	Pupae	Total
1	35.77	21.71	18.67	0.64	19.31
4	26.54	1.30	0.91	0.0	0.91
7	20.26	1.14	0.76	0.0	0.76
10	27.23	2.45	0.07	0.0	0.07
13	13.59	5.93	4.43	0.0	4.43
16	5.79	0.33	0.65	0.0	0.65
19	4.02	3.11	5.78	0.0	5.78
22	16.92	3.97	1.54	0.0	1.54
25	24.48	4.06	8.31	0.0	8.31
28	40.01	3.08	0.95	0.0	0.95
31	20.11	4.86	5.72	0.0	5.72
34	16.80	2.19	1.80	0.0	1.80
37	27.45	1.77	5.49	0.0	5.49
40	18.53	5.13	0.40	0.0	0.40
43	55.88	4.23	1.26	0.0	1.26
46	18.23	1.50	1.02	0.0	1.02
49	36.01	3.71	1.10	0.0	1.10
52	24.94	3.89	0.89	0.0	0.89
55	28.29	2.58	2.34	0.0	2.34
58	11.29	9.21	2.67	0.0	2.67
61	8.96	0.23	0.59	0.0	0.59
64	5.38	3.44	4.30	0.0	4.30
67	23.12	6.58	7.03	0.0	7.03
70	7.70	5.26	7.55	0.0	7.55
73	40.70	40.78	40.31	0.21	40.53
Means	22.32	5.70	4.98	0.03	5.02
S.E.	2.53	1.68			1.69

Biscara-Martinez Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
454	26.49	--	--	--	--
460	20.52	--	--	--	--
466	32.80	--	--	--	--
472	12.23	--	--	--	--
475	7.74	--	--	--	--
481	13.63	--	--	--	--
487	50.66	--	--	--	--
493	16.19	--	--	--	--
505	14.01	5.54	12.82	0.0	12.82
511	12.76	12.77	9.81	0.0	9.81
517	25.15	21.06	5.03	0.0	5.03
523	38.98	17.62	0.79	0.0	0.79
526	18.23	4.12	3.38	0.0	3.38
529	41.04	12.56	8.19	0.0	8.19
535	56.03	12.78	1.13	0.0	1.13
544	47.07	12.91	1.23	0.0	1.23
550	25.30	10.17	1.90	0.0	1.90
553	11.01	2.56	0.10	0.0	0.10
556	18.23	17.58	2.73	0.0	2.73
562	19.62	15.34	3.99	0.12	4.11
565	9.84	20.80	2.76	0.0	2.76
574	21.28	27.01	2.58	0.0	2.58
583	57.73	23.96	0.26	0.0	0.26
589	20.29	4.81	3.16	0.0	3.16
598	28.01	9.44	0.29	0.0	0.29
Mean	25.79	13.00	3.54	0.01	3.55
S.E.	5.16	1.75			0.87

Tusas-Willow Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
151	33.75	28.91	28.63	0.0	28.63
157	11.30	10.74	10.75	0.0	10.75
163	22.90	7.86	7.02	0.0	7.02
169	21.11	24.21	14.80	0.0	14.80
172	35.85	25.06	26.87	0.0	26.87
181	25.66	10.08	3.78	0.0	3.78
187	26.36	7.63	5.16	0.0	5.16
193	20.65	5.01	2.11	0.0	2.11
199	37.66	10.78	8.41	0.0	8.41
203	18.70	8.89	3.85	0.0	3.85
214	33.27	2.98	0.35	0.0	0.35
223	35.06	3.69	0.40	0.0	0.40
232	3.57	20.94	21.38	0.0	21.38
235	20.20	19.74	8.79	0.0	8.79
241	29.53	2.70	1.92	0.0	1.92
247	78.77	28.52	4.77	0.0	4.77
253	16.69	12.61	3.57	0.0	3.57
259	15.16	2.50	0.66	0.0	0.66
265	55.79	19.59	12.06	0.0	12.06
268	25.91	3.10	0.49	0.0	0.49
274	19.73	5.33	0.90	0.0	0.90
277	17.23	24.18	9.42	0.0	9.42
283	27.99	11.04	6.43	0.0	6.43
289	17.08	9.53	3.27	0.0	3.27
295	47.55	16.86	11.44	.09	11.53
Mean	27.88	12.90	7.89	0.003	7.89
S.E.	3.09	1.73			1.58

Hopewell Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
301	19.10	1.53	0.15	0.0	0.15
304	15.91	3.95	1.03	0.0	1.03
307	33.67	5.95	0.50	0.0	0.50
310	15.07	2.14	1.33	0.0	1.33
313	36.19	3.17	1.51	0.0	1.51
316	30.56	4.44	0.70	0.19	0.90
319	25.35	2.04	0.24	0.0	0.24
322	10.39	5.61	3.86	0.0	3.86
325	11.93	0.37	0.10	0.0	0.10
328	8.65	1.49	0.14	0.0	0.14
331	24.73	3.12	0.61	0.0	0.61
334	11.84	2.99	1.55	0.0	1.55
337	21.73	2.19	1.14	0.0	1.14
340	8.47	2.49	0.0	0.0	0.0
343	23.76	7.37	2.57	0.0	2.57
346	36.23	6.15	0.96	0.0	0.96
349	19.32	1.58	0.29	0.0	0.29
352	50.20	3.34	0.0	0.0	0.0
358	--	2.50	--	--	--
361	8.21	2.92	1.62	0.0	1.62
364	18.16	12.63	10.60	0.13	10.71
Mean	21.47	3.71	1.44	0.02	1.46
S.E.	2.53	0.59			0.53

Carson NF Zone

Red River Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
376	12.07	2.48	1.95	0.0	1.95
379	17.60	8.80	2.06	0.0	2.06
382	6.21	2.46	0.09	0.0	0.09
385	10.96	--	--	--	--
388	12.59	--	2.49	0.0	2.49
391	8.35	--	0.0	0.0	0.0
394	16.75	--	1.01	0.0	1.01
397	29.31	2.54	1.74	0.0	1.74
400	9.70	--	1.09	0.0	1.09
403	14.76	--	0.65	0.0	0.65
406	10.49	3.63	1.45	0.7	1.52
409	20.28	--	1.82	0.0	1.82
412	17.63	3.17	0.89	0.0	0.89
415	23.81	--	1.07	0.0	1.07
Mean	15.04	3.87	1.25	0.01	1.26
S.E.	1.70	1.00			0.21

Rock Creek Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
76	5.92	1.99	1.78	0.0	1.78
79	10.10	--	--	--	--
82	19.63	30.82	5.26	0.12	5.38
85	24.71	18.85	15.26	0.22	15.48
88	63.68	--	--	--	--
91	27.34	14.98	8.12	0.13	8.26
94	21.77	1.58	0.64	0.0	0.64
97	15.05	3.46	1.28	0.29	1.57
100	9.57	--	--	--	--
103	16.46	--	--	--	--
106	4.79	--	--	--	--
109	14.56	8.77	10.28	0.31	10.59
112	24.58	2.86	4.40	0.0	4.40
115	39.20	14.85	1.22	0.0	1.22
118	14.73	13.44	4.99	0.0	4.99
121	39.16	8.41	10.55	0.0	10.55
124	37.57	11.97	6.53	0.14	6.66
127	38.71	8.93	3.00	0.0	3.00
130	32.87	12.97	8.91	0.0	8.91
133	47.75	6.16	0.88	0.0	0.88
136	42.64	6.57	1.31	0.25	1.55
139	44.48	11.94	2.54	0.08	2.63
142	5.07	1.52	1.10	0.0	1.10
145	16.31	7.51	4.42	0.0	4.42
148	8.27	1.27	1.23	0.0	1.23
Mean	25.0	9.93	4.69	0.08	4.76
S.E.	3.14	1.64			0.92

State and Private Zone

American Creek Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
1	16.67	5.50	5.33	0.0	5.33
2	17.31	1.62	1.57	0.0	1.57
3	9.69	2.03	1.94	0.0	1.94
4	6.97	2.16	1.03	0.0	1.03
5	9.89	0.84	0.0	0.0	0.0
6	8.09	2.15	0.28	0.0	0.28
7	8.86	6.33	3.35	0.0	3.35
8	9.43	7.08	3.73	0.0	3.73
9	3.71	7.57	3.67	0.0	3.67
10	16.66	1.96	0.91	0.0	0.91
11	7.24	1.69	0.0	0.0	0.0
12	7.06	0.38	0.96	0.0	0.96
13	19.53	5.42	4.73	0.0	4.73
14	8.17	1.48	0.28	0.0	0.28
15	10.36	2.76	1.47	0.0	1.47
16	7.08	1.75	4.01	0.0	4.01
17	15.88	6.10	5.39	0.0	5.39
18	23.79	9.86	2.10	0.0	2.10
19	11.70	1.51	0.0	0.0	0.0
20	5.34	7.59	3.95	0.22	4.18
21	13.04	4.66	3.24	0.0	3.24
22	13.09	7.89	5.31	0.0	5.31
23	11.13	4.82	3.34	0.0	3.34
24	11.33	3.83	2.75	0.0	2.75
25	7.89	9.48	8.02	0.0	8.02
Mean	11.20	4.26	2.69	0.01	2.72
S.E.	0.96	0.57			0.42

Agua Fria-Saladon Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
1	28.86	26.16	12.04	0.0	12.04
2	9.34	3.52	4.18	0.0	4.18
3	7.13	5.97	5.06	0.0	5.06
4	9.25	3.18	5.45	0.0	5.45
5	14.51	4.97	8.99	0.0	8.99
6	8.85	3.39	10.46	0.0	10.46
7	8.70	8.28	5.99	0.0	5.99
8	10.18	9.17	6.58	0.11	6.69
9	6.01	3.45	3.95	0.0	3.94
10	6.37	2.98	3.63	0.0	3.63
11	30.15	18.14	13.58	0.0	13.58
12	9.54	4.10	2.70	0.0	2.70
13	30.50	10.76	7.61	0.0	7.61
14	47.97	15.80	0.71	0.0	0.71
15	32.99	3.03	11.98	0.0	11.98
16	12.29	3.05	8.29	0.6	8.35
17	18.46	1.53	3.61	0.0	3.61
18	15.99	10.05	2.32	0.0	2.32
19	13.32	3.72	1.69	0.15	1.85
20	11.94	1.23	1.46	0.0	1.46
21	7.23	2.14	0.76	0.0	0.76
22	3.94	2.32	2.05	0.0	2.05
23	7.86	1.94	0.79	0.0	0.79
24	6.81	2.08	2.17	0.0	2.17
25	18.78	3.64	5.22	0.0	5.22
Mean	15.08	6.18	5.25	0.11	5.26
S.E.	2.17	1.21			0.76

Nine Mile Creek Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
1	11.10	10.65	2.37	0.0	2.37
2	3.35	1.44	0.29	0.0	0.29
3	14.19	7.14	6.92	0.0	6.92
4	4.89	3.28	2.57	0.0	2.57
5	7.18	4.62	3.71	0.0	3.71
6	12.53	5.29	1.10	0.0	1.10
7	7.17	2.54	0.83	0.0	0.83
8	3.66	1.38	0.45	0.0	0.45
9	5.44	2.82	0.88	0.0	0.88
10	6.58	4.04	0.92	0.0	0.92
11	16.65	1.60	3.39	0.0	3.39
12	7.41	7.64	5.75	0.0	5.75
13	12.61	5.45	7.52	0.0	7.52
14	13.15	2.95	1.16	0.0	1.16
15	4.61	2.19	0.0	0.0	0.0
16	10.39	8.96	2.38	0.0	2.38
17	13.28	3.26	2.06	0.0	2.06
18	16.78	4.80	4.04	0.0	4.04
19	15.89	1.97	0.0	0.0	0.0
20	9.91	0.52	0.0	0.0	0.0
21	12.78	3.71	1.12	0.0	1.12
22	5.51	2.62	1.28	0.0	1.28
23	8.97	3.88	1.45	0.0	1.45
24	3.86	0.42	0.88	0.0	0.88
25	5.49	4.71	6.60	0.0	6.60
Mean	9.34	3.92	2.31	0.0	2.31
S.E.	0.86	0.51			0.45

Mutz Spray Block

Plot No.	Plot means--budworms per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
1	4.65	1.20	1.36	0.0	1.36
2	5.81	2.35	1.11	0.0	1.11
3	7.18	6.26	2.39	0.0	2.39
4	10.12	4.05	1.36	0.0	1.36
5	6.28	4.98	0.55	0.0	0.55
6	6.83	1.98	2.25	0.0	2.25
7	15.35	5.14	3.92	0.25	4.17
8	19.79	6.61	5.68	0.0	5.68
9	9.63	7.40	3.26	0.0	3.26
10	8.20	2.89	2.42	0.0	2.42
11	13.32	3.97	0.40	0.0	0.40
12	9.80	0.76	0.17	0.0	0.17
13	6.19	1.07	0.91	0.0	0.91
14	12.47	5.22	2.03	0.0	2.03
15	20.19	1.05	0.0	0.0	0.0
16	5.27	0.80	1.09	0.0	1.09
17	13.56	5.91	2.72	0.0	2.72
18	2.49	2.42	2.73	0.0	2.73
19	6.54	0.17	1.11	0.0	1.11
20	5.67	3.16	0.49	0.0	0.49
21	7.21	2.39	1.51	0.0	1.51
22	5.57	3.49	1.45	0.0	1.45
23	7.34	6.28	3.46	0.0	3.46
24	12.54	6.45	2.02	0.0	2.02
25	8.66	0.0	0.17	0.0	0.17
Mean	9.22	3.44	1.78	0.01	1.79
S.E.	1.39	0.46			0.27

State and Private Zone

B.t. Areas

Plot No.	Plot means--budworms per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
1	17.75	1.42	2.08	0.0	2.08
2	7.92	2.14	5.16	0.0	5.16
3	7.15	2.44	1.93	0.0	1.93
4	16.35	1.41	1.75	0.0	1.75
5	10.03	3.65	2.21	0.0	2.21
6	2.35	8.18	0.73	0.0	0.73
7	0.75	11.10	0.45	0.0	0.45
8	5.13	4.94	1.73	0.0	1.73
9	4.48	6.10	0.33	0.0	0.33
10	5.25	5.51	2.80	0.0	2.80
11	8.70	1.79	2.91	0.0	2.91
12	17.97	1.31	2.55	0.0	2.55
13	8.58	2.53	5.03	0.0	5.03
14	7.14	4.62	2.93	0.0	2.93
15	6.70	5.24	2.94	0.0	2.94
16	Not sampled	1.68	2.55	0.0	2.55
17	Not sampled	9.74	4.11	0.0	4.11
18	Not sampled	2.85	4.27	0.0	4.27
19	Not sampled	6.91	6.75	0.0	6.75
20	Not sampled	10.99	6.80	0.0	6.80
21	Not sampled	11.14	5.10	0.0	5.10
22	Not sampled	4.36	0.68	0.0	0.68
23	Not sampled	5.77	3.52	0.0	3.52
24	Not sampled	15.27	6.59	0.0	6.59
25	Not sampled	15.91	10.96	0.0	10.96
Mean	8.42	4.40	3.47	0.0	3.47
S.E.	1.35	0.68			0.49

Hematite Spray Block

Plot No.	Plot means--budworm per 100 buds				
	Prespray larvae	7-day postspray larvae	14-day postspray		
			Larvae	Pupae	Total
1	12.95	1.76	2.49	0.0	2.49
2	10.72	5.67	2.25	0.0	2.25
3	13.25	2.06	1.00	0.0	1.00
4	17.28	3.16	1.71	0.0	1.71
5	9.37	4.13	1.89	0.0	1.89
6	4.01	0.86	1.40	0.23	1.63
7	8.47	4.42	3.10	0.0	3.10
8	26.15	5.23	4.96	0.0	4.96
9	13.05	1.57	3.62	0.0	3.62
10	17.09	3.89	2.44	0.0	2.44
11	16.18	1.97	7.51	0.0	7.51
12	7.81	3.67	2.25	0.0	2.25
13	7.69	2.52	3.81	0.0	3.81
14	12.86	2.48	4.12	0.0	4.12
15	20.36	7.87	7.68	0.0	7.68
16	8.71	1.28	1.79	0.0	1.79
17	18.31	3.24	1.08	0.05	1.12
18	17.60	10.99	4.11	0.0	4.11
19	5.86	0.61	1.58	0.0	1.58
20	23.51	14.45	13.09	0.0	13.09
21	33.47	9.61	16.02	0.0	16.02
22	13.10	3.64	2.23	0.0	2.23
23	11.54	3.73	2.00	0.0	2.00
24	16.60	2.02	4.42	0.0	4.42
25	4.68	4.90	1.28	0.12	1.39
Mean	14.02	4.22			3.93
S.E.	1.39	0.68			0.73

APPENDIX C

ORGANIZATION CHARTS

FIGURE 1. Project administrative team for the 1982 western spruce budworm suppression project

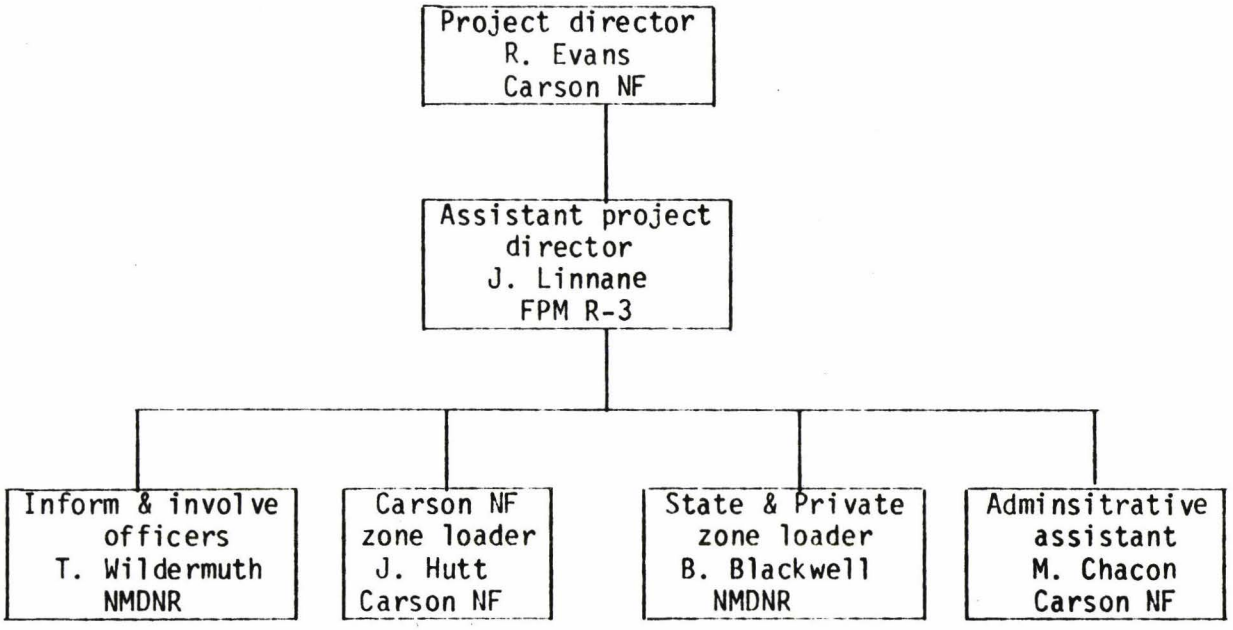


FIGURE 2. Carson National Forest zone organization chart for the 1982 western spruce budworm suppression project

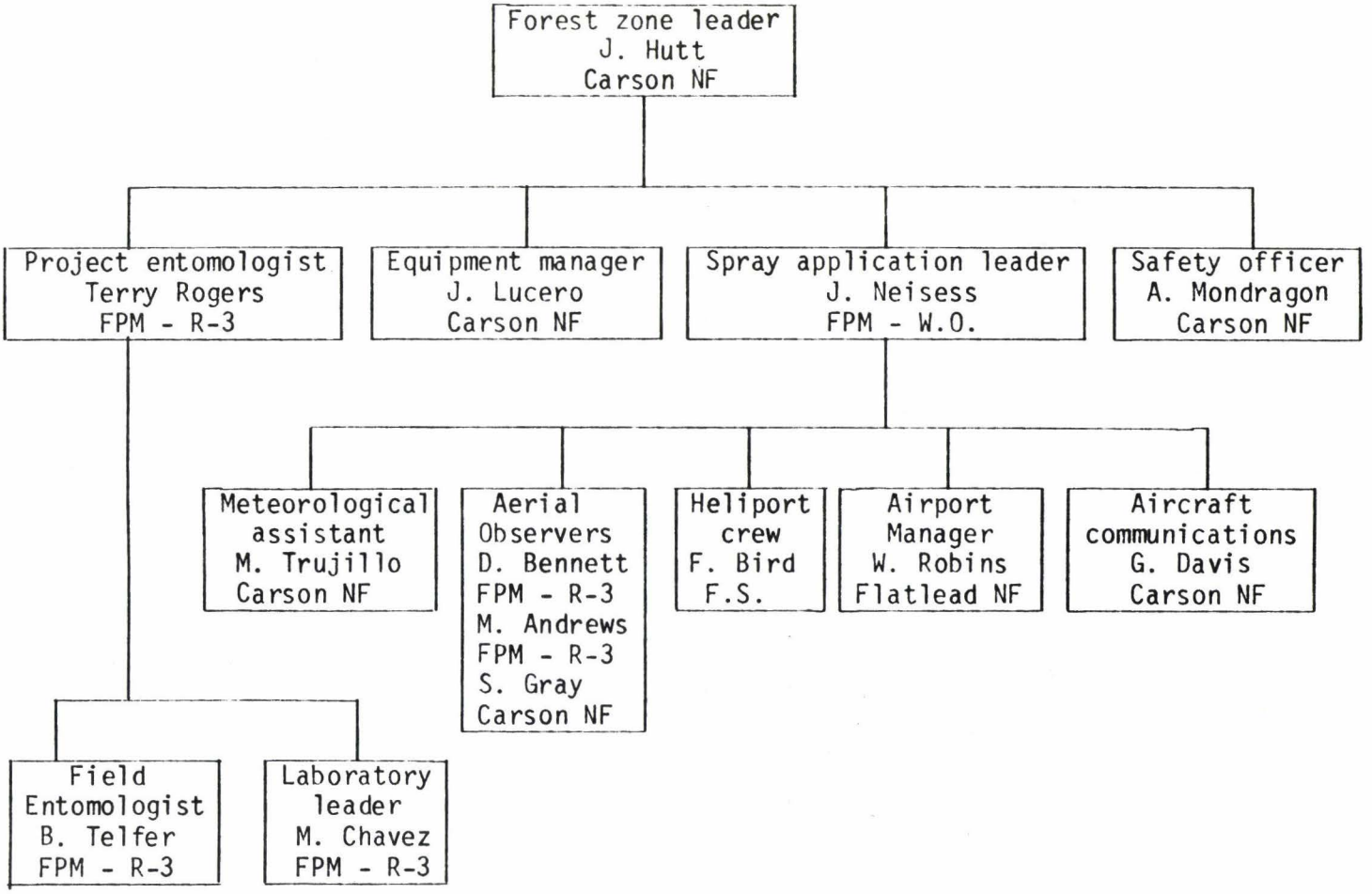
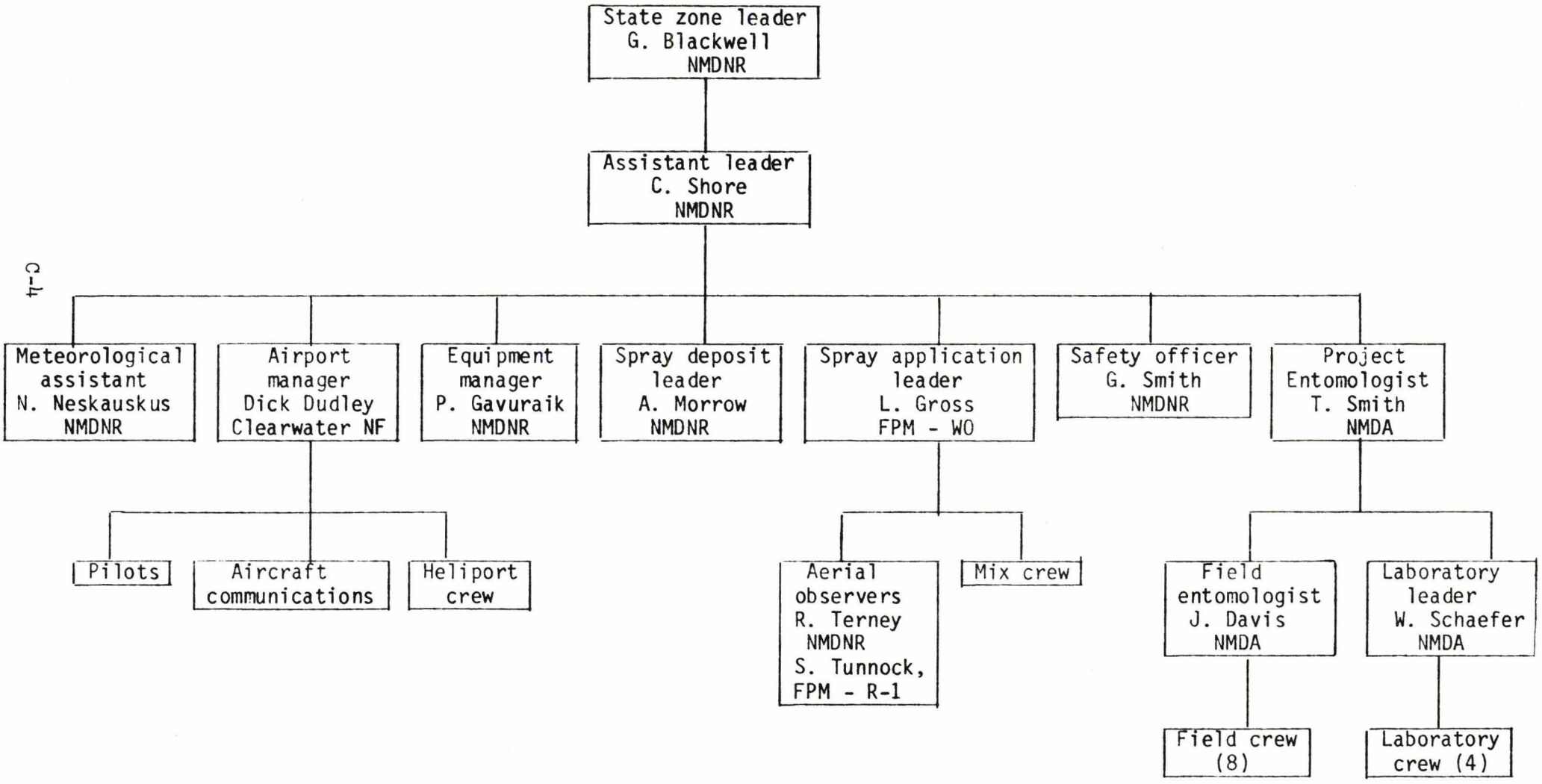


FIGURE 3. State and private zone organization chart for the 1982 western spruce budworm suppression project



Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key--out of the reach of children and animals--and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honeybees or other pollinators are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.